EXTENSION CONFERENCE

NICOLLET HOTEL

Minneapolis, Minnesota

November 2 - 3, 1948

REGIONAL EXTENSION CONFERENCE

Minneapolis, Minnesota

November 2 and 3, 1948.

The Regional Extension Conference met at 9:00 a.m., Tuesday, November 2, 1948 in Parlor D, Nicollet Hotel.

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The meeting was called to order by Chairman, Ralph D. Mercer.

WEED CONTROL

R. S. Dunham - "Where are we in Weed Control"*

The question asked in the title of this discussion immediately suggests that its answer must be relative. Where we are in weed control must be answered in terms of where we started and how far we are going. It suggests a journey along the road of weed control development that began in the distant past and is headed for the dim future.

I am sure that weed control began with agriculture, for early agriculture consisted of man's attempt to encourage the growth of desirable plants at the expense of undesirable ones. For centuries weed control, cultural and tillage practices developed together. Little research was necessary because the principles of controlling weeds by cultivating were very simple. Those interested in the subject studied it from the viewpoint of the taxonomist and ecologist and the literature consisted of lists of weeds found under certain environments together with descriptions of plant and seed for identification purposes. In 1879, Dr. Beal began his famous seed-longevity studies while Crocker in 1906, Oswald in 1908, Beach in 1909, and Shull in 1911 reported on various weed seed viability studies. Bolley in 1895, Brenchley in 1911, and Stone in 1915 were interested in the ecology of weeds. It wasn't until 1930-36 that Brenchley and Warington published on weed-seed populations of the soil and the effect of cropping and tillage practices. Arny in 1932 and Pavlychenko in 1934 contributed information on root reserves and competition. The important Lamberton studies of field bindweed were begun in 1936.

Not much progress was made with chemical weed killers until the latter part of the 19th century. Copper salts, iron sulphate, and sulphuric acid were in use about 1896. From that time until 1910 interest in weed control lapsed. In 1915 the arsenicals, carbon disulphide, and sodium chlorate were advocated. It was in 1933 that Sinox was used as an herbicide in France and not until 1937 that it was introduced into the U.S. Although many earlier studies with plant hormones had laid the foundation for the use of 2,4-D as a weed-killer, it was in 1942 that Slade, Templeman, and Sexton in England made known their results with methoxone to other workers and 1944 that Hamner and Tukey announced the herbicidal properties of 2,4-D in the U.S.

The development of organized interest in weed control has likewise been slow. Until recently, weeds have been considered primarily the problem of the individual farmer. Even as late as 1937 the U.S.D.A. objected to the Clark Weed Bill introduced into Congress because it felt that the noxious weed problem was one which the individual

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* Paper No. 644 of the Miscellaneous Journal Series, Minn. Agricultural Experiment Station.

farmer should solve for himself. Quoting L. W. Kephart from an article in Agricultural Chemicals, "Strangely, weed control is one of the last great problems involved in agricultural production to receive the attention of biological science. Other pest problems, such as insects, rodents, and plant and animal diseases, have been subjected for more than a hundred years to the scrutinizing eyes of scientists. In the U.S. alone, for a quarter century or more, there have been constantly on public and private payrolls more than a thousand professional entomologists devoting their entire time to intensive studies of the life histories, habits, and control of insects."

"During the same period, nearly a thousand plant pathologists, several hundred animal pathologists, and scores of specialists in diverse other kinds of pest control have been busily engaged in research on those problems. Yet, there were in the U.S., as recently as 15 years ago only 3 full-time weed control specialists. In 1930 our knowledge of insect and disease control was already enormous; our knowledge of weed control was elementary. For all practical purposes, in 1930 we knew scarcely more about weed control than had been known to every good farmer for centuries."

The seriousness of the weed problem in the U.S. today can also be blamed on the lack of organized prevention. Most of our bad weeds are imported species and yet even today there is no adequate provision for keeping them out of the country in seed and screenings. Sketchily, I have tried to show how far back this road of weed control stretches and some of the landmarks along the way.

Where are we now? Well, I believe we are on a smoother piece of the road, we are going to travel faster, and we are going to have more sign posts to keep us headed in the right direction. The advent of 2,4-D in the U.S. and methoxone in other countries has provided a tool such as was never known before. At first, exaggerated claims were made. "Forces the toughest weeds to absorb it and commit suicide"; "all trace of bindweed is gone within six days;" "the weeds get tremendously oversexed." A nation-wide advertising campaign sold enormous quantities of 2,4-D and it demonstrated beyond any doubt that what everybody needed and wanted was some accurate and dependable information. It demonstrated conclusively that empirical information was not enough, that sketchy field trials were inadequate, that the principles involved were deeply hidden and complex, and that a lot of real research by technically trained men was essential. As a result, we are now engaging in that sort of research all over this country and several others. There is organized support for it. The Congress is making money available through the Hope-Flannagan Bill, State appropriations are being upped, private industry is contributing grants and fellowships. There is a general understanding of the weed problem such as we have not had. There are now, according to Kephart, more than 100 full-time weed specialists at work; there are at present two, with a probability of four, U.S.D.A. coordinators who work closely with state men. There are three regional weed conferences in the U.S. such as our North Central Weed Control Conference, and similar organizations in Canada. In Minnesota we now have the State Bureau of Plant Industry which is placing an emphasis on weed work. The program for weed control at this University is coordinated by two committees, one for the research staff and one for extension, an organization of work that is found in other institutions as well.

Technically, there is much to learn but a considerable fund of information is already available. I can do no more than cite a few illustrations realizing that I am omitting much more than I present. One of the first 2,4-D formulations on the market sold for 94 cents an ounce; today it can be bought for 17 cents. Rates of 2,4-D three years ago were standardized at 1 1/4 lb. acre for selective spraying. Today rates are closer to 4 oz. with even less of the ester. Volumes have dropped from 160 gals. per acre to 5 for ground sprayers and less for airplanes. It is known now that varieties of crops may differ in their response to 2,4-D applications and strains of weeds may also react variously. Originally considered primarily for perennial

weeds, 2,4-D is now one of our best selectives, used on grain crops and also on flax. The early fears that treatment might result in injured germination or mutations and other genetic upsets have largely been dispelled. In spite of a vast ignorance about all growth regulating substances and in spite of some disappointments, the use of 2,4-D is on a practical basis.

There has been a new approach to cultural investigations also. The earlier simple concepts of the principles involved have yielded to a more scientific attitude that is reflected in recent investigations along that line.

Korsmo has made very comprehensive studies of weed control by a wide variety of methods. Arny's work with root reserves was fundamental. Valuable contributions to information on plant competition have been made by Blackman and Templeman, Pavlychenko, Norris, Brenchley, Wilson, Larson, and Stahler, and very recently by Robinson. The studies by Chepil and Crocker et al on germination of weed seeds under a variety of environments are very helpful. These are but a few of the investigators that could be mentioned. They have all helped to make cultural and cropping methods more effective.

What do we see ahead on this road of weed control development? There are too many bends to see clearly and we shall have to guess at what lies beyond them. Probably chemicals are here to stay. The objections to the inorganics that have been used in the past have been largely met in 2,4-D. It is non-poisonous, non-corrosive, relatively cheap, non-inflammable, and has no lasting injurious effect on the soil. The di-nitros have some of these attributes also but 2,4-D is less expensive, it requires less water, and it is not so easily affected by environment. The work of Buchholtz at Wisconsin indicates that perhaps 2,4-D may be used on legume seedings without the injury once believed to be certain. These facts together with the decreasing use of di-nitros on flax and even peas apparently point to their replacement in a large way by newer chemicals. The objection to all the organic chemicals on the market during the last few years is their failure to control grass weeds. However, trichloreacetate and phenyl mercuric acetate are promising herbicides for these weeds. In fact, it is easy to believe that the potential of organic herbicides is greater than we can now comprehend.

Whether the chemicals are here to stay will depend on how well they compete with cultural practices in cost and effectiveness or --- and as I think more likely --- whether they can be complements of cultural methods. Will farmers use chemicals when prices for their products fall? Will they turn to the cultivator and harrow because they are already a part of their equipment and represent no additional expense? I have already pointed out that prices of 2,4-D have been greatly reduced. So have rates. The combination results in very cheap acre-cost in many instances. It may not be beyond reason to believe that a weed sprayer may soon become an essential part of farm equipment. There are weedy places inaccessible for tillage, there is the problem of erosion as a result of tillage, there is the danger of spreading weed patches by cultivation, there are instances of reduced productivity following a fallow. In such circumstances perhaps the chemicals can compete very successfully with tillage. On the other hand, there is the problem of drift with chemicals that injure neighboring susceptible crops. Some weeds are so tolerant of the chemicals that they are ineffective against them and some crops are too susceptible to be sprayed. Mechanical damage from hauling spray machinery through the crop fields may be avoided by pre-emergence spraying but at present it is so little understood that no recommendations can be made. Perhaps it can also be avoided by the use of airplanes but there are problems associated with this method of application also. Chemicals may injure crop quality even though yield is not reduced. What neither tillage nor chemicals can accomplish alone, they may well accomplish together. A tremendous contribution has been made to agriculture by the plant breeders through improved varieties, by the soil scientist through fertilizer

and other soil management practices, by the plant pathologist and entomologist in the control of diseases and insects, by the agricultural engineer through a multitude of labor saving devices. Weed control research can provide information to bring production closer to realizing the potentials released through these other applications of research.

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W. W. Brookins - "Use of Weed Control Practices by Farmers".

A survey was conducted in three test counties for the purpose of establishing the present status of the use of weed control practices among farmers. It was also considered desirable to learn as far as possible the contributing factors which might interfere with greater adoption of practices which could improve the situation in the flax crop. Some measure of progress made as a result of publicity programs was needed which might also serve as a basis for comparison in subsequent years. Personal observation can be most misleading unless some sound basis of judgment is available. Use of personal survey technique on a random basis can be recommended to Extension specialists without reservation as there are many real advantages to be gained in the personal farm contact. Where opinion is asked of a few exponents of a practice, their answers lead one to think that is the accepted way. In making this survey we found exponents of August-plowing as a preparation for flax were just as strong for it as those who follow corn with flax were strong for that practice. A true random sampling gets both views and a statistical answer which comes closer to indicating the actual case.

Three counties were selected as representative of an area where approximately 50 per cent of the flax acreage occurs in the state of Minnesota. In each of the three counties ten townships were selected at random, and within each township ten sections were likewise selected. A survey record was completed on one farm per section. Selection of three test counties, however, was not made at random as certain characteristics indicated these counties might give a more accurate picture of the area sampled.

As the three counties were centrally located in a group of sixteen counties, it was expected the data would provide a good basis for estimating the situation and needs for specific emphasis in furthering adoption of effective weed controls.

Characteristics of Area

The sixteen counties as shown in Figure 1 are characterized by a relatively high flax, corn and oat acreage. The corn acreage in most cases slightly exceeds the combined acreage of oats and flax. The three test counties are similar in this respect to the total area. In addition, owner-operated farms averaged 55.4 per cent where the sixteen counties averaged 58.8 percent for this statistic. The problems of crop sequence are very similar and the practice of alternating corn and small grains appears to be very common throughout. These figures are shown in Table I.

Table I. Crop Characteristics of Survey Area

	Flax acreage 1947	Corn acreage 1947	Oat acreage 1947	No. of farms	No. of owners
Total 16 counties	517,258	1,915,480	1,151,671	31,820	18,668
Average	32,328.6	119,717.5	71,979.4	1,988.7	1,166.7
Estimated 1948	784,860				58.8%
Total 3 test counties	122,835	456,061	262,256	6,963	3,855
Average	40,945	152,020.3	87,418.7	2,321	1,285
Estimated 1948	162,688 = 32.4% increase.				55.4%

Based on the 1947 Minnesota State Farm Census there are 31,820 farms in the area, of which 76.8 percent are flax growers. Figured from our 1948 survey these flax growers grew an estimated 784,860 acres of flax. The average number of flax acres per grower is indicated at 35.5 acres.

Table II. Flax Growers in Test Counties

County	Flax growers %
Lyon	94.6
Nobles	78.0
Renville	51.4
Average	76.8

It has been shown experimentally and on a practical farm basis that weed reduction in the flax crop and increased seed yield can be obtained where flax is sown on August-plowed grain stubble properly handled for weed control. The tremendous competition of corn for this land is apparent from the figures shown in Table I. The flax acreage when not seeded down is commonly August-plowed according to the 1948 survey figures, and is planted to corn or soybeans the following season. However, this supplies less than one-third the acreage needed for corn and the remaining corn acreage must come from oat ground and other small grains, soybeans, and the occasional pasture fields which may be plowed. Whenever oat ground, August-plowed is reserved for flax, a proportionate acreage of corn stalk land must be replowed for a second year in corn. Fall plowing on corn stalk land is sometimes very difficult when maturity is delayed or when winter snows occur early in November.

A relatively small proportion of the corn acreage is put into the silo and this corn acreage can be fairly readily prepared for small grains or flax or replowed for corn and soybeans. In the light of these circumstances some very strong motives are required to bring about a change in the common practice of sowing flax on disked corn ground.

August-Plowing

In seeking to encourage the use of August-plowing of grain stubble as a weed control

the publicity campaign has apparently produced some striking results. In both 1947 and 1948 there has been a very high farm participation in the use of this practice. Publicity has been directed at all farmers, regardless of whether or not they produced flax. In 1944 emphasis on the use of August-plowing was given in the booklet "Weeds in Flax". In 1946 the Flax Institute featured the practice in conjunction with a general flax booklet on production practices. This was enlarged somewhat in 1947 and during the summer of 1947 a special booklet was put out on August-plowing. Again in 1948 a new version of the August-plowing weed control booklet was presented along with posters, with newspaper publicity in both years. It was found that in 1947 90.1 percent of farmers plowed their grain stubble in August, and in 1948 this increased to 98.1 percent. While August-plowing has been considered an old established practice, earlier observations had indicated the practice was not too widely used. There appears little doubt the publicity campaign is partly responsible for the wide scale use of this weed control practice during the past two seasons.

Stubble available for August-plowing is made up mainly from the flax and oat crops, with wheat and barley acreage of lesser importance. A relatively small acreage of oat and flax fields is seeded down to legumes and grasses which would thus reduce in a small degree the number of acres which can be plowed at that time of year. In general, fields of flax not seeded down can be August-plowed and would go into corn or oats or other small grains the following season. On the other hand, August-plowed oat stubble would be available for corn, soybeans and flax the following season. Use made of this land by farmers in 1948 and plans for 1949 are shown in Table III.

Table III. Percentage of Farms on Which Various Crops Follow August-Plowed Grain Stubble

Use	Percent 1948	Percent 1949
Corn	87.1	94.4
Soybeans	16.0	22.8
Oats	8.0	1.5
Flax	22.4	16.7

The above data represent the usage of August-plowed stubble by both flax growers and non-flax growers. From these figures it is very clear that the common practice is to plant corn on plowing and to a lesser degree flax and soybeans. Many of these farms had both corn and flax or flax and soybeans on plowing so that totals would greatly exceed 100 percent. It would also appear that less flax would go onto plowing in 1949 than in 1948, but this fact is related to the high percentage of renters who were not certain if they would have the farm the following year or what arrangement would be made with the landlord. The support price for 1949 would also be a factor in making plans for flax acreage in 1949.

Flax growers are using August-plowing for preparation of flax to a much greater degree than data in Table III indicates. While 87.1 percent followed small grains with corn, 31.2 percent also used a part of the grain stubble for flax in 1948. In addition, 5.4 percent of the flax growers prepared hay or pasture by August-plowing for flax. Both of these latter preparations are very beneficial from the standpoint of weed control and the combined usage of these two preparations indicates that 36.6 percent of flax growers obtained benefit of weed control and increased yields where their August-plowed land was properly handled.

Table IV. Flax Growers Using August Plowing As Preparation for Crop.

County	August-plowing flax %
Lyon	44.3
Nobles	28.2
Renville	36.0
Average	36.6

In addition to a strong publicity campaign, high flax seed prices have also been a factor in encouraging use of better land for flax. Correct definition of better land from a farm viewpoint can be regarded as a clean (low weeds) productive field. The wide scale use of August-plowed grain stubble for corn affords ample evidence of farmers' regard for this land.

Both flax growers and non-flax growers appear to hold the practice in high regard. Farmers in general consider August-plowing as good weed control as indicated by 97 percent committing themselves on this opinion. In the fall of 1947, 89.8 percent of flax growers August-plowed grain stubble and 89.3 percent of non-flax growers did likewise. The publicity campaign on August-plowing appears to have been recognized well by all groups of farmers if the degree of acceptance is any indication of the effectiveness of that program.

Other Cultural Controls

Another general weed control indicative of farm initiative to meet the problem of perennial weeds is effort expended late in the fall on quack and thistle patches. Of the total farmers apparently 31.5 percent go after their weeds just before freeze-up. Often corn picking extends well into the period when the ground is frozen. Seasonal conditions and lack of help on farms just before freeze-up undoubtedly reduces the amount of late fall working which can be done. This is a place where chemical sprays could very advantageously supplement cultural controls. Whether to spray stubble fields immediately after harvest and delay plowing or to plow immediately and spray later is a question which remains unanswered as to the best procedure. In our opinion immediate plowing after harvest and spraying in September as soon as perennial patches appear seems to be more logical. August-plowed fields this season had to be worked in September to prevent annual weeds from going to seed. Destruction of these weeds by sprays would be preferred as disking land and bringing up new weed seeds onto the surface would be avoided. The advantage is obvious in that a dead cover would also remain on the fields over winter. When worked in September, it is very often too late for any cover to develop. This could be a very important factor in areas troubled by soil blowing.

Maturing of perennial weeds in grain crops has been one means of weed spreading that has been attacked through regulatory methods. Attempts have been made to prevent seeds of these weeds from spreading at threshing time by wind. Mowing or destruction of the weeds before flowering in the grain crops has been the main approach. This probably serves mainly to avoid spreading on grain racks, in threshing machines and sifting of the seeds along roadsides as the grain is hauled to market as fewer seeds are likely to be found in the crops when they are handled. A high proportion of farmers apparently are doing something about this as 91.3 percent indicated they had cut or sprayed thistles wherever they found them. The remainder do not admit to having thistle on the farm and in some cases are probably correct.

Effectiveness of smother crops in the control of thistle, spurge and field bindweed has been well established at the Lamberton Station. Well attended field days have afforded opportunity for farmers to see the operations and results in the past. However, very few of the farmers contacted knew what a smother crop is, and only 23.5

percent had used soybeans, sudan grass or millet in the recommended manner for this purpose. Another 9.6 percent used alfalfa mainly as thistle control and another 4.5 percent used other crops including fodder corn, rye, buckwheat, and sweet clover as smother crops. In general, about 38 percent of the farmers employed smother crops in the last two years, but this was apparently restricted to owner-operated farms. Few, if any, renters could be expected to devote their efforts on this type of control unless the cooperation between landlord and renter was particularly good.

Chemical Controls

Chemical spraying of weeds with 2,4-D formulations has taken hold very rapidly compared with earlier experiences in the use of Sinox. Use of chemical on farms was indicated at 81.7 percent, and included 2,4-D, sodium chlorate, and one case of Sinox. Actually 74.5 percent of the farms used one or two or the 2,4-D formulations, 7.2 percent still relied on sodium chlorate and the remaining 18.3 percent relied on cultural practices if at all.

Most widely used was the amine on 32.3 percent of the farms; 27 percent used the ester and 5.3 percent the sodium salt. Another 19.4 percent used 2,4-D but were uncertain as to the type.

Oats were sprayed on 63.9 percent of the farms as apparently most men felt this was the safest crop to try it on. More farmers raised oats than did flax, but the fact may also indicate the oat crop was very weedy. In the case of flax, 43.1 percent of the farms sprayed weeds in this crop and corn and pasture 38.0 and 29.2 percent respectively. Of the flax growers, 57 percent sprayed weeds in their crop. Other crops on which the spray was tried out included wheat, rye, barley, alfalfa and soybeans. On the legumes the result was what might be expected, but these were perennials on which the spray was applied in small patches.

The percentage of farmers using chemical sprays in the three counties is shown in Table V.

Table V. Farms Using Chemical Sprays

Counties	Spray %
Lyon	87.0
Nobles	82.0
Renville	74.3
Average	81.7

A high percentage of 2,4-D users might indicate farmers had thrown caution to the wind and had applied the chemicals on everything in sight. But this was not the case as 68 percent indicated only patches had been sprayed and 23.6 percent only had sprayed entire fields. Comparing the oat and flax crops separately, 28.6 percent of the oat fields and 20.8 percent of the flax fields were entirely sprayed. Corn fields received sprays only on the perennial weed patches. Spraying of entire flax and oat fields was done mainly because of heavy infestations of mustard and other broadleaved weeds which would have cut yield seriously anyway. In these cases growers reported clean crops and good yields.

Attitude of some flax growers to use of 2,4-D on the crop is somewhat reflected by several men who stated they plan to put flax on August-plowed ground so they will not have to spray the entire field but only the perennial weed patches. Cost of spraying a large acreage is also an important item with most growers. There was no sound basis for estimating the effect of the chemical on crop yields, as untreated areas in fields sprayed were not left for comparison. In the case of patches sprayed, often the ester was used strong enough to kill the crop too. Otherwise, using recommended rates of application, thistle patches were set back sufficiently that the crops were harvested

on the treated areas as contrasted with having to mow these areas before the crop matured. Accordingly, some 34 percent of the farms using 2,4-D considered they had obtained an increase in yield.

The amount of patch spraying with 2,4-D throughout the area may also give some indication of the prevalence of centers of perennial weed infestation. The data indicate that at least 68.2 percent of the farms have Canada thistle areas. The actual figure is probably higher than this as another 7.2 percent used chlorates obviously for the same purpose and about 18 percent did not use any chemical.

Weed Control Means Higher Crop Yields

Of the three counties studied, Lyon has shown by far the greatest use of weed control practices and has applied them in production of flax to the greatest extent. Average yields for Lyon County are indicated at 16 bushels, Nobles at 13 bushels, and Renville 12.5 bushels.

Over a period of nine years oat and flax yields in the three counties indicate that soil productivity and season may not be sufficiently different to result in large differences in crop yields. Flax yields in Lyon County in 1948 appear to have exceeded Nobles by 23 percent and Renville by 28 percent. Yields of flax seed and oats are given in Table VI from 1940 to 1948 inclusive.

Table VI. Flax Seed and Oat Yields

	Nobles		Lyon		Renville	
Year	Flax	Oats	Flax	Oats	Flax	Oats
1940	14	36	12	34	12	33
1941	14	31	13	21	11	24
1942	11	37	13	42	11	52
1943	11	35	12	33	10	34
1944	5	32	8	37	8	32
1945	13	48	13.5	55	14	52
1946	14	41	14.5	48	13	39
1947	14.5	43	11	32	13	33
1948	13		16		12.5	
Average	12.2	37.9	12.6	37.7	11.6	37.3

The evidence however, points strongly to the greater use of weed controls as the important contributing factor. Data gathered in the same group of counties in 1947 indicated a possible 2.7 bushel increase in yield for August-plowing as compared to disked corn ground. In 1948 average yields on August-plowing indicated 16.8 bushels, whereas corn ground averaged 13.3 bushels, a 3.5 bushel difference in favor of August-plowing. These figures are subject to considerable error as conditions under which the two sets of data were established were extremely variable and not comparable.

Despite a very satisfactory record in Renville County on weed control use, flax yields have not risen in proportion to what might be expected. This appears to be related to a heavier initial weed infestation than the other two counties. In 1941 and 1942 Renville County showed a lower average purity of flax seed stocks, probably related to heavier weed infestation in general. In the 1947 crop census it is also revealed this county had 30 to 40 thousand more acres not under cultivation and a higher acreage of wild hay land than the other two test counties. Many of these areas are low and wet at certain seasons, ideally situated for harboring centers of perennial weed infestations. Where these areas are not readily accessible to machinery use or are not along the frequented routes about the farm, infestations may go unobserved and unchecked for several years. Renters particularly are not likely to spend time and money on weed control on this unproductive land. Supporting data are given in Table VII. and Table VIII.

Table VII. Flax Seed Quality Available for Sowing 1941 - 1942

County	Seed stock Average purity % 1942	1941
Lyon	87.4	95.0
Nobles		93.3
Renville	85.7	90.4

Table VIII. Unattended Areas As a Source of Weed Seed Spreading

County	Acres not used for crops*	Wild hay acres*
Lyon	89,261	9,563
Nobles	79,392	10,911
Renville	125,509	17,665

* Data from 1947 census.

Accordingly, all factors considered it appears probable that about a 2 bushel or 14 percent increase in yield has resulted from better weed control in Lyon County. Figured from indicated acreage of flax for the county in 1948 with the farm price of $5.75 per bushel, the 2 bushel increase means a bonus of over $835,000 for weed control. Even when costs of various weed controls are considered, a handsome profit still remains.

In our opinion the experience of flax growers in Lyon County in 1948 illustrate the principle that county wide weed control over a period of years makes possible expression of higher crop yielding capacity when seasonal conditions are favorable.

Other Factors Influence Adoption of Weed Controls

Perhaps the most recurrent factor that interfered with greater weed control adoption was the landlord tenant relationship. Renters invariably referred to the problem of landlord and tenant paying a fair share of weed control costs. In some cases it was apparent that neither of the two groups had much consideration for good weed control. On the other hand, situations were en countered where landlords had followed a very generous policy in regard to weed control costs.

Uncertainty of having the farm the following year, either at the expiration of a lease or as a result of short term leases, frequently deterred renters from engaging in needed controls. In the case of flax, ability to make definite advance plans for land preparation is vital to securing maximum returns from the crop. Likewise, knowledge of factors which would influence price the following year is needed in August.

In order to gain greater advantage of weed control, reasonable policies need to be developed in regard to these points. Landlords as well as tenants need to be well informed on the most effective weed controls and what their use can mean to their business arrangements. Some measure is needed to establish the manner and rate at which different controls will bring financial benefit to each group. An evaluation of the effectiveness of different controls would contribute greatly to this particular problem. Controls which bring the renter more immedicate profit and those which have a cumulative effect on land values and soil productivity over a period of years require consideration as to which group shall pay the major cost.

The problem is complex, but is worthy of the efforts of the best minds in weed control research and agricultural economics.

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Robert Robinson - "Cultural Practices for Weed Control".

Cultural methods of weed control are considered to include crop rotation, tillage, competitive cropping, grazing, or any other system of farm management other than the use of chemicals that may aid in weed control.

Perennial Weeds. Research on bindweed at Lamberton, sowthistle at Crookston, leafy spurge at Underwood, and Canadian Thistle in Meeker, Goodhue, Douglas and Redwood counties was presented.

1. Fallow interval of two weeks to one month was more economical and just as effective as fallow at weekly intervals.

2. Fall competitve crops - rye, winter wheat.

3. Summer competitve crops - corn, sudan, soybeans, sorgo and millet.

4. Alfalfa and Reed canary grass.

5. Crookston work on sow-thistle control.

6. Bindweed control by grazing rye-sudan grass pasture with sheep.

7. Leafy spurge control with sheep.

Annual Weeds -

1. Effect of rate of seeding on annual weeds and crop yield. As rate of seeding decreased from 56 lb. per acre, straw yield and seed yield decreased and weed plant yield increased.

2. Post emergence harrowing of small grain and flax has on the average, resulted in a 40% reduction in weed plant yield but has not affected crop yield.

3. Comparisons of weed-free flax, wheat, and oats vs. flax, wheat and oats with moderate infestations of lambs-quarter and pigeon grass have frequently shown yield reduction due to weeds but not always. Weeds less than 6 inches tall provided most of the competition for wheat and oats in these trials, and weeds over 6 inches tall provided most of the competition for flax. Crops completely weed-free at 4 inches yielded almost as well as crops kept completely weed-free till harvest. Plant tissue tests for NO_3, P_2O , K_2O and a soil aeration test showed NO_3 to be the only limiting factor. Soil moisture was not limiting, and soil temperature was higher on the weed-free plots than on the weedy plots. The NO_3 was deficient on both weed-free and weedy plots.

4. Yield of flax plant was negatively correlated with yield of pigeon grass at each of nine weekly harvests from mid-June to mid-August. At maturity,

flaxseed and flax straw yields were negatively correlated with pigeon grass yield.

5. Rotation and tillage studies conducted at St. Paul, Morris, Crookston, Waseca, Sacred Heart, and Danube were discussed.

Preliminary results indicate that weed-free corn is superior to corn with normal cultivation in yield of flaxseed and flax straw the following year. Also the flax is less weedy, and the soil weed seed population is lower. Although weed-free corn may be a pratical impossibility at the present time, the use of chemicals and the flame cultivator give some hope for the future.

Oat stubble plowed or disked in August gave as good yields of flax the following year as did corn kept weed-free. Soil moisture conditions in August and September may be an important factor determining whether August plowing or August disking is preferable.

Fall plowing of oat stubble without any post harvest weed control has been inferior to weed-free corn and to August tilled oat stubble in flaxseed and flax straw yield.

In conclusion, cultural methods are an important phase of weed control, but little work has been done in combining cultural and chemical methods; this phase of work may become more important in the future.

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W. P. MacDonald - "Field Spraying Equipment for Weed Control".

"Refer to back of this report".

"State Reports on Weed Control".

Ralph D. Mercer - Montana.

Weed Control in Montana, like every other state, is wild. However, it is gratifying to see this interest after working many years on weed control without any interest being shown.

In the last year a weed specialist has been employed in Montana. Robert Warden, Montana State College graduate, was employed half time Research and half time Extension.

Twenty counties out of 56 have organized weed districts in operation under the state weed law. There are several more counties in the process of organizing districts. County budgets amount to a total of $300,000.

Selective weed spraying enjoyed a real boom this year. Over one million acres of wheat were sprayed for the control of annual weeds. Nearly 600,000 acres of other crops were sprayed. Most of the control material was used in the spray form, by ground equipment. Very little air treatment was performed. There will be more air treating next year.

Weed Control work is on the March!

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Chas. J. Gilbert - South Dakota

The South Dakota Weed program was activated approximately April 1, 1947 and has operated with a State Weed Board office and supervisors since that time.

The law provides for a State Weed Board and permits counties which are organized in conformance with the Board's regulation to appropriate funds for weed control. Forty-seven counties have county weed boards and thirty-four made appropriations for weed control. These funds ranged from $500.00 to $12,000.00 per county.

Good cooperative relationships exist between the U. S. Forest Service; the South Dakota Department of Game, Fish and Parks; Federal Wildlife Service; State Highway commission; County Commissioners, and, in general, the railroads.

We have made a conservative estimate of 6000 sprayers in operation this year; the actual figure may be much more. Estimates of number of acres where chemical weed control was practiced range from one million to more than two million. Estimates of average increased net income from weed control range from $1.00 to $9.00 per acre. Some instances were as high as $30.00 per acre. If the smallest figure for both acreage and return is used the percentage of return for the amount expended by State government was at least 2000% profit on the investment.

One county agent who had very detailed figures from which to arrive at his conclusions estimated his county profited by $7,000,000.00 because of weed control activity.

In cooperation with the South Dakota Experiment Station, a 16 page weed bulletin was published under the title of "Chemical Control of Weeds". This has been reprinted until 30,000 have now been sent out.

A small circular entitled, "Checking a Weed Sprayer", was published similarly and was very popular at field meetings. 10,000 were printed.

A bulletin on cultural practices for weed control was printed. This has now run out of print and a reprint will be made shortly by the experiment station.

The Weed Board developed, had printed, and presented to each county in the state a permanent weed record book based on a large sheet per township with subdivisions as small as 160 acres.

As a work sheet 40,000 individual form maps were prepared, printed and distributed to counties.

At present a monthly news sheet on weed control named the "South Dakota Weed Fighter" is being mailed to county weed boards, county agents, community weed representatives, neighborhood leaders, county commissioners and other leaders in the weed control program.

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Russell B. Widdifield - North Dakota

North Dakota estimates at least 1½ million acres treated with chemicals for weed control. Some injury was reported from improper application. They report approximately 8,000 ground spray rigs and expect an increase in weed spraying next year. They report poor results from pre-emergence spraying. The State Weed meeting was held in 1948 and plans are going forward for a similar meeting in 1949.

The following figures based on surveys, estimates and observations of county agents throughout the state. All figures are estimates and approximate.

1. Acreage Treated 2,4-D.

Total Acreage	1,570,000 A.
In growing crops	1,460,000 A.
Other	110,000 A

2. Method of application:
   - 66% ground spray
   - 21% airplane spray
   - 7% ground duster
   - 6% airplane duster

3. Acreage of crops treated:
   - 63% spring wheat
   - 9% oats
   - 15% barley
   - 9% flax
   - 3% summer fallow
   - 1% rye, corn & other

4. Injury reported:
   27 counties report some damage
   Most on small acreage and slight damage.

   Total damage reported represent less than 1% of acreage treated.

   Most damage result of overdose or wrong stage of maturity.

5. Type Rigs applying 2,4-D.
   5391 privately owned, all types.
   292 custom rigs, all types.

   Of Privately owned
   5273 ground spray
   69 ground duster
   45 airplane spray
   4 airplane dust

("State Reports on Weed Control" - continued)

5. Of Custom Rigs
168 ground spray
21 ground duster
86 plane spray
17 plane dust

Believe estimate of number of ground sprayers very conservative and is actually nearer 8,000.

6. Weeds treated Not in Crop
Total Acreage - 110,000 A.

Field bindweed	17%
Sow Thistle	9%
Canada Thistle	8%
Russian Knapweed	3%
Leafy Spurge	2%
Other	2%
Annual Weeds	59%

7. Pre Emergence Tried Out
17 counties tried out small scale.
Not recommended
Most all - not effective.

8. Application of Dinitros
Total Acreage 16,656 A.
Flax 11,613 A
Small grains 5,043 A

Injury reported on one field

9. Sodium chlorate & Borax used
Chlorate and Atlacide - 601,000 lbs.
Borax 86,000 lbs.

Total of 344 tons
20% Field Bindweed
50% Leafy spurge
20% Quack grass
5% Russian Knapweed
5% Other

10. Other Chemicals Tried Out.
4 counties reported trying out small demonstrations with T. C. A., ammate and 245T.

11. Agent's Estimates of use of 2,4-D in 1949.

Every agent, without exception expected slight to big increase.

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Ralph F. Crim - Minnesota

Minnesota reported the distribution of approximately 55,000 weed control circulars and that farmer interest in weed control never has been greater. Very fine co-operation has been shown from the commercial interests in giving accurate information to farmers, especially is this true relative to weed control chemicals. The county agricultural agents have all worked on a weed control program and the University has had the cooperation of the Regulatory Departments in holding a Weed Short Course last winter.

County acreages were checked rather carefully for noxious weeds and one county agent reported that a weed control meeting was held in every school district in his county.

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("State Reports on Weed Control" - continued)

George M. Briggs - Wisconsin

Wisconsin reports fine progress in the weed control program. Good cooperation between the State Department of Agriculture and the Agronomy Department in holding many county weed meetings and in giving many radio programs. Along the educational line I might state that during the past nine months, which is a continuation of the previous year, we have given radio talks every other week on keeping up with the war on weeds. I also send out a timely newsletter to all county agents entitled "Weed Flashes".

In cooperation with the Agricultural Engineering Department this last year between December and May 1, we had sectional meetings in some parts of the state with our county agents and we also had meetings in forty counties giving detailed information on type of equipment, machinery to be used in a weed program as well as discussions on the various chemicals and problems concerned with a weed control program.

There were 71 Wisconsin counties of which 55 had a definite weed program assigned to the county extension office. Our sprayers were found to the extent of 10 in the smallest counties up to 300 in some counties. We have used approximately 150 tons of chemicals this past year, mostly 2,4-D and a very small amount of the dinitros. There are still a few areas using sodium chlorate. There are only two counties in the state that have weed commissioners and most of them have the regular township systems.

We have one county organized entirely on the school district plan which plans to revolutionize the weed control work when properly subsidized and when the county agent has been given sufficient time to carry through with the educational details. This year he had meetings in 135 of 155 school districts.

We feel that the problem of determining amounts applied per acre has been simplified by O. Berge of the Agricultural Engineering Department whereby any operators can easily determine application rates. It consists in the following: Measure a 40 rod distance and spray at the regular rate of travel and the regular normal pressure. Measure exactly the amount of chemical used to cover this 40 rods and use the following formula. The number of gallons used multiplied by the figure 66. Divide this by the width of the boom and this will give the gallonage per acre.

Our publications have been on 2,4-D and one bulletin each on what to look for in buying spray outfits as well as methods of making home spraying outfits.

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E. P. Sylwester - Iowa

Weed control in Iowa, up till now, has constantly tried to focus attention on the worst perenniel weeds which we have in the state. Namely, the ones embraced in the Weed Law. This focusing of attention was done in full knowledge of the fact that the common, more numerous, annual weeds were probably responsible for infinitely more crop losses than the noxious weeds. However, educational work on the use of pure, weed-free seeds and emphasis on good cultural control practices such as repeated, thorough working of the ground before the crop is planted and after it is in, and shallow cultivation in row crops after the crop is up, have been emphasized

E. P. Sylwester - Iowa

constantly in our program of weed control in addition to our work with the primary noxious weeds. Thus, while we have constantly trued to focus attention on the worst primary noxious weeds, we have also tried to broaden our scope of weed control through the use of good seed and through the use of proper cultural practices such as good seed, the use of clean cultivation, the use of any method which prevents weeds from going to seed, the use of good rotations, and the use of smother crops. It must be admitted, however, that up until the present time, we have had practically no chemicals which we could recommend on an acreage basis which would accomplish remarkable, almost unbelievable control of at least broad leaved weeds in crops. We now have such materials which will help make our annual weeds much less prevalent in many of our cultivated crops. With the coming of 2,4-D, terrific impetus was given to weed control. Never, perhaps with exception of the reception given Clinton oats, has there ever been more interest by farmers, manufacturers, and the general public in weed control. Tremendous success stories are almost common, every-day, occurrences. In Iowa, all counties were reached by correspondence and meetings. Sometimes on a district basis but actually 74 counties were contacted by individual weed meetings during the year. All of the counties which requested help were given such help. The weed specialist conducted 193 meetings on weed control in the form of supervisory board meetings, regional field days, district extension training schools, weed committee meetings, county project meetings, institutes, tours, field days, exhibits, pest control conferences, demonstrations, night schools, and 4-H groups. The total number of meetings had a total attendance of 133,019. This group of people was by far the largest ever contacted in organized weed control meetings during any one year and reflects the tremendous current interest in weed control work, much of it due to the new weed killing chemicals.

Every county was given an opportunity to secure information at district weed days. Five of the major chemical companies sold over 100,000 gallons of 2,4-D concentrate in Iowa this year. Attendance at all meetings was astounding and gratifying. In addition, the specialist made 32 farm visits to problem areas, visited 19 result demonstrations, made 30 radio talks, prepared 21 press articles, and wrote 2753 first class letters in furtherance of the weed control program. One cooperative bulletin with the State Department of Agriculture was published and 30,000 copies distributed. Two major articles were published in Iowa Farm Science and 30,000 copies of each were distributed. Three major articles were reprinted from Hoard's Dairyman and at least ten mimeographed articles on the control of weeds were prepared or revised.

For lawn and cemetery spraying, we have usually recommended spraying with the salt form of 2,4-D at the rate of one-half, three-fourths, or one pound per acre, depending upon the type of weed which was to be killed out. Excellent results were secured in all spraying. However, cases of injury from contaminated sprayers, spray drift, etc., continue to appear.

In pastures, fence rows, ditch bank, and roadside spraying, universally good results were secured where conscientious spraying has been praticed. Under-dosage, due to misunderstanding of the label, has resulted in some poor kills, Some roadside weeds and brushy plants are resistant to 2,4-D. We have advocated only the esters wherever the primary undercover is grass, such as is found along roadsides, ditch banks, fence rows, etc. Some instances of injury due to spray drift have resulted. We have recommended about one-half to one pound of 2,4-D ester form per acre for the types of weeds found in such areas. The Bell Telephone Company has approximately 15,000 miles of telephone lines in Iowa and they have sprayed under about 5,000 miles of wire this year. This is largely for the eradication of brush.

("State Reports on Weed Control" - continued)

E. P. Sylwester - Iowa

In small grain, universally good results have been accomplished in the control of marsh elder, ragweed, lambsquarter, hemp, and mustard. We have recommended the ester form at the rate of about one-fourth pound per acre or the amine form at the rate of one-half pound per acre. As control of weeds became more effective the legume stands were badly decimated and as weed control became less effective, more legumes survived. Alfalfa is the most sensitive of the legumes. A warm, dry spring makes small grain as well as weeds a little hardier to spray injury.

In flax we recommend one-eighth pound per acre of the ester form or one-fourth pound per acre of the amine form. In flax it is highly important that the recommended dosages are never exceeded. While excellent results were secured, there was usually a noticeable reaction on flax at first. This was usually outgrown in from 48 to 72 hours. Yields have been good. Warm, dry spring weather hardened the flax as well as the weeds, In one instance where flax was sprayed on a 30 acre field, the yield was 20 bushels per acre. Undoubtedly the warm dry spring also hardened off the flax to where it was a little bit more resistant to the 2,4-D sprays.

In corn we recommended one-fourth pound ester or one-half pound of amine per acre, depending to some extent on the type of weed which was present. We recommended drop extensions and surveys have indicated that less injury was suffered by the corn when using these drop extensions than when spraying was done from the top. However, this has not always been the case. We recommend spraying when the corn is from one to three feet high and just before it is laid by. Often it is indicated that much earlier spraying is highly desirable. However, early in the growth of the corn there are usually very few weeds present which cannot be taken care of by means of good cultivation. The later the spraying can be done, therefore, the more of the established broadleaved weeds will be controlled by the spraying. In Iowa, there were many instances where farmers sprayed when the corn was from four to eight inches high with no visible injury. We had a warm, dry spring, the corn was extremely slow growing. Then the extremely rainy spell caused the growth rate to increase tremendously. Some of the sprayed corn became brittle and broke off during cultivation or a high wind. Consequently some injury was suffered by some farmers. However, if the weeds were heavy enough to warrant spraying in the first place, the injury which was suffered through brittleness was much more than offset by the increased yields of corn which still remained. The very fact that this was the first year that very extensive areas of corn have been sprayed, that Iowa produced a new per acre record yield of 61 bushels of corn, and the biggest corn crop in the history of the state is mute evidence of the fact that a tremendous amount of good was accomplished by using 2,4-D as a weed killer in corn.

Much of the experimental work has involved a study of the tolerance of various crops to 2,4-D spray dosages, both pre-emergence and post-emergence. In oats, pre-emergence and post-emergence spraying with 2,4-D emphasizes the severe effect of 2,4-D on legume seedlings. If it were not for this hazard, small grain would certainly be the place to use 2,4-D in a weed killing program. This legume seedling hazard is a definite limitation of the use of 2,4-D in small grain in Iowa. Flax can be safely sprayed using the ester form at the rate of one-eighth pound per acre before the flax is 10 to 12 inches high. This results in fairly good control of susceptible weeds. Dosages must be kept down and one-eighth pound per acre should be regarded as a maximum dosage. In soybeans, two preliminary tests with 2,4-D pre-emergence sprays gave conflicting results. A third test yielded some promising results which need further checking. In corn, the major research emphasis has been on the tolerance of corn to the various dosages of 2,4-D. Pre-emergence sprays on corn gives good enough weed control to save at least two cultivations. No injury to the

("State Reports on Weed Control" - continued)

E. P. Sylwester - Iowa

corn was noted at the recommended rates. Post-emergence spraying tests designed to test various dosages and formulations of 2,4-D indicate strongly that tolerance of corn to 2,4-D depends not only on the dosage applied but also on the stage of development, rate of growth at the time of spraying, and growth conditions before and after spraying. Results this year tend to substantiate the dosage recommendations of previous years.

We have more requests for regional field days and pest control conferences and individual county meetings than we have ever had before. Surveys indicate that 35% of Iowa farmers have used weed sprays during the past season. Practically all of them were highly satisfied with the results obtained. There were approximately 1,000,000 acres of oats and 1,000,000 acres of corn sprayed in Iowa this last season. The trend in most spraying seems to be toward about 10 gallons of solution per acre.

There will be continued increases in all phases of pest control, including weeds, for a few more years, after which they will become established farming practices. In weed control we intend to sponsor a state weed control meeting, regional pest control conferences, and individual county meetings on weeds. We feel that the field is just beginning to open up and that, at long last, we have materials which can be used on an extensive scale to combat the weed problem in Iowa. While the 2,4-D compounds admittedly are not perfect weed control chemicals, they can be implemented with other chemicals and will be improved as time goes on so that the chemicals now on the market, plus the ones which will be on the market, within the next few years, will give us excellent control and perhaps reduce our weed manace to a minimum.

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CORN BORER CONTROL

H. L. Parten - "Results of Minnesota Corn Borer Survey"

The 1948 corn borer survey has not been tabulated up to the present time. However, looking over reports or findings from individual counties, indications are that the heavier corn borer populations are moving West. Due to the sudden drop of temperatures after the first brood of moths had started to emerge, there was a cessation of emergence until the temperature warmed up again. This condition caused an upset in the earlier predictions of corn borer damage by the first generation. It seems that corn borer damage in the heavily infested areas was very spotted due to weather conditions. Most of the severe damage occurred in planting of sweet corn throughout the southern part of the state. Many growers resorted to the use of DDT for corn borer control. Here again we ran into varying results due mostly to the errors in time of application. Some growers received perfect control after spraying, and others could see little or no results. The counties in the southwestern part of the state where in 1947 we found it rather difficult to find corn borer infestation had a different picture in 1948 as corn borer infestations were very easy to find in this area. This indicates there will be a heavier population of this insect in 1949. However, it is an impossibility to predict what the population will be in the Spring of 1949 as this will depend upon weather conditions at the time of emergence. The State

H. L. Parten- "Results of Minnesota Corn Borer Survey" - continued

Entomologist's Office and the University Extension Service has conducted field demonstrations in the proper setting of plows in order to insure complete trash coverage in old corn fields. These demonstrations have been very successful with very large attendance at all, which indicates an interest in this phase of corn borer control, which in itself is a good agronomic practice as it returns the organic matter to the soil. The University has now employed one full time specialist, Dr. Holdaway, who will be in charge of the research in corn borer control.

It is hoped that through this research more will be known about the ecology of the corn borer in Minnesota and better and more effective control measures recommended in the near future.

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M. L. Armour - "Cultural Practices for Corn Borer Control".

Minnesota has held demonstrations with several types of machinery to demonstrate proper covering of corn stalks for corn borer control. A portion of the field was disked down and plowed under, in another section of the field the stalks were chopped and moldboard plows and disk plows were used for the demonstration. Both 14" and 16" moldboard plows and disk plows were used and four rounds were made with each. Wires were attached to the moldboard plows to assist in turning the stalks under. The use of a disk or a stalk chopper was not found to be of any help, especially when a 16" moldboard plow or disk plow were used. Chopping and disking of stalks did prove of value when plowing under with a 14" moldboard plow. They reported more chopped stalks were turned up than whole stalks after the plowing was disked.

A discussion of the corn borer and its habits was held at every meeting and Machine Company representatives discussed the proper adjustments of the machines demonstrated at each meeting. They had an average attendance of 200 people at each demonstration.

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Harold Gunderson - "Corn Borer Control in Iowa".
(prepared by Harold Gunderson, given by E. P. Sylwester).

Winter Mortality of Borers

For some reason the winter of 1947-48 was very hard on corn borers. In the past, we have never found more than 10% of the overwintering borers killed by weather. Early spring surveys in 1948 indicated an average winter mortality of 60% this year.

Spring Weather

Iowa had an extremely hot, dry May. Many borers were killed by these high temperatures before pupation and many emerging moths were found with deformed, non-functional wings due to the heat.

During the normal oviposition period, cold windy, wet weather was unfavorable for oviposition and as a result of all these factors, our first brood of corn borers was small.

First Brood Treatment

Earlier, we had anticipated that 500,000 acres would be treated for first brood

(Harold Gunderson - "Corn Borer Control in Iowa" - continued)

borer. Actually, about 200,000 acres were treated, 110,000 by airplane. About 100,000 acres were treated too late to do any good, due to high-pressure selling, mostly by airplane companies. Where treatment was applied at the right time, very good results were obtained. Yields were increased by 5 to 20 bushels per acre through the application of 1 to 1½ pounds actual DDT per acre, most of it by tractor mounted sprayers as 5 to 8 gallons of spray per acre at 35 to 75 pounds pressure. Three nozzles per row gave the best coverage.

Educational Activities

Through OFFC funds, 13 corn borer scouts, hired in May, kept track of pupation, emergence, and egg-laying. The first eggs were found in southeast Iowa on June 3. The number of egg masses per 100 plants and the height of the tallest corn in which examinations were made was reported by districts daily in newspapers and over the radio stations of the state. These counts were intended to serve as guides only. Each farmer was expected to make his own counts and to treat his fields accordingly.

A large number of winter meetings, field days, and field meetings taught many farmers how to look for borer eggs, equipment to use, how to use it, what DDT formulations to buy, and how to use them.

Our spring educational work saved the farmers of Iowa well over $1,500,000 in sprays that were not applied for first brood corn borer. If farmers had gone ahead blindly, they would have applied treatments needlessly to the tune of the above sum.

Second Brood Treatment

We had very favorable weather for the second brood of borers. Only 10,000 acres were treated for second brood, but where applications were timed properly, results were good.

1948 Losses

The fall survey shows 77 counties with more than 100 borers per 100 stalks. The high county (Marshall) has an average of 589 borers per 100 stalks and the state average is nearly 200 borers per 100 stalks as compared to 105 for 1947. The minimum loss from borers in 1948 amounted to $60,000,000 - mostly from second brood borer and does not include the loss from broken stalks, dropped ears, and longer picking time.

Outlook for 1949

We are going into the winter with the largest borer population we have ever had, and with an alert farmer population which will be better prepared than ever before to destroy these overwintering borers by destroying corn crop residues mechanically.

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George M. Briggs - "Corn Borer Control in Wisconsin".
(Prepared by E. Fisher, given by George M. Briggs).

Introduction

About three and one-third million pounds of DDT dust was applied for European corn borer control in Wisconsin in 1947. Most of this was applied in the southern half of the State, however some was applied as far north and west as Polk and Barron counties.

Possibly due to a high winter mortality of borers, and consequently less moths for oviposition, much less control by means of insecticides was carried out in 1948.

Educational Field Programs

Fall Demonstrations: For the past three years, during the month of October the Agricultural Engineering and Economic Entomology Departments have cooperated in holding European Corn Borer Control Demonstrations, featuring Clean-Plowing Contests. These one-Half day field meetings have included:

1. Discussion on the borer life history, showing damage done to corn stalks and ears.

2. Discussion of control measures such as dusting or spraying, clean-plowing, and stalk-shredding.

3. Demonstration of airplane and/or ground dusters and/or sprayers for application of insecticide.

4. Clean-plowing contest, 50 points of each plowman's score being judged on trash coverage.

5. Demonstration of such machines as the Rosenthal Cornbine which shreds stalks.

6. Discussion on plow adjustment and hitch in order to do clean-plowing most efficiently and economically.

Thirty-two of these demonstrations have been conducted during the years 1946 thru 1948, with an estimated average attendance of about 1450 per demonstration.

Spring Demonstrations: During late June and early July, practical field meetings are held to acquaint corn-growers with egg masses, hatching, and methods of applying insecticides.

Observations Of The 1948 Season

A cooperative program between the U.S.D.A. and the Wisconsin Agricultural Experiment Station resulted in findings that there was a very heavy winter mortality of borers in most sections. In addition, there was an agreement between these cooperating agencies in Wisconsin, as well as in some nearby States that this condition of high winter mortality should be stressed publicly. This was done, as well as stressing the recommendation that corn should not be treated with insecticide until at least 50 egg masses per 100 plants were found in a field.

So far as Wisconsin is concerned, this publicly stressing of high winter mortality was a very premature and unscientific bit of information, since no comprehensive work had been done previously to substantiate the impression conveyed to corn growers. Further, it seemed ridiculous to increase the recommendation for egg mass count from 25 to 50 per 100 plants, when the lower number proved satisfactory in 1947.

It is granted that there was much less total borer damage in 1948 than 1947. However, some fields of corn were as heavily infested this year as any observed in 1947. Oviposition occurred over an extended period, therefore there was usually a comparatively low number of egg masses on corn at any particular date during the moth flight period. Continuance of the 25 egg masses per 100 plants as a recommendation for time to apply insecticide would have been more suitable during the 1948 season when egg-laying was done over an extended period.

Counties where (application of insecticide) for European corn borer control were made in 1947.

U. J. Norgaard - "Corn Borer Control in South Dakota".

South Dakota reports corn borer infestation ranging from 10 to 26 per 100 stalks, Union, Clay and Lincoln Counties and part of Yankton and Turner Counties. They further report a 5 to 10% infestation in Bon Homme, Hutchinson, McCook, Minnehaha, Lake, Moody, and Brookings Counties: and 2 to 5% infestation in Deuel, Hamlin, Kingsbury, Miner, Sanborn, Davidson and Hanson Counties. The balance of the eastern one-third of the state shows approximately 1% infestation. The policy of the Extension Service is to keep their Extension personnel and farmers informed of the situation.

Corn borer control schools were held by county extension agents at which time Dr. G. B. Spawn and Dr. H. L. Chada discussed the problems. County agents plan to discuss corn borer control at the winter meetings to better inform corn growers of the situation.

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SAWFLY SITUATION

E. G. Davis - "Summary of Wheat Stem Sawfly Research Activities During 1948". (Prepared by E. G. Davis, presented by H. L. Parten).

In addition to an allotment of $6,000 from regular funds available to the Bureau of Entomology and Plant Quarantine of the United States Department of Agriculture, for research on the wheat stem sawfly, $15,000 was made available to that Bureau under the urgent Deficiency Appropriations Act of 1948 for expansion of its work during the current calendar year. The Department Administrator of the Research and Marketing Act of 1946 also allotted $20,000 to the Bureau of Entomology and Plant Quarantine for sawfly research, and $10,000 to the Bureau of Plant Industry, Soils, and Agricultural Engineering for the development of sawfly resistant varieties of wheat, from funds available under that Act for the current fiscal year. With these resources, a research staff has been established at Minot, North Dakota, and at a small sub-station at Choteau, Montana, and studies have been initiated by the Department of Agriculture on the biology of the sawfly and on its control by cultural and insecticidal methods and the development of resistant varieties of wheat, in cooperation with the Montana and North Dakota Experiment Stations. Surveys in cooperation with the above-mentioned State Experiment Stations to determine the distribution, abundance and importance of the sawfly are also being continued under the regular and deficiency funds available to the Bureau of Entomology and Plant Quarantine.

The main emphasis during the past season has been on investigations of control measures and surveys. During June and July field trials were made with four different chemicals, namely; parathion, DDT, benzene hexachloride, and chlordane. These materials were applied to field test plots weekly throughout the flight period of the adults as dusts and sprays to kill them before they could lay eggs. None of the treatments resulted in practical control although chlordane gave some promise. Parathion dust was also applied to the soil in an attempt to get the growing wheat plants to absprb enough of the chemical to become toxic to the larvae feeding within the wheat stems. The result of this treatment was not promising.

Cultural control experiments were started this fall after harvest. Infested wheat stubble at the North Central Experiment Station at Minot was given various treatments soon after harvest with the following implements:

(1) deep plowing with moldboard plow

(2) medium plowing with a one way disc plow

E. G. Davis - "Summary of Wheat Stem Sawfly Research Activities During 1948" - cont'd.

(3) shallow plowing with a one way disc plow

(4) shallow plowing with a one way disc plow followed by a rod weeder

(5) Graham Homme plow with shovels

(6) Noble blade.

The effects of these treatments will be determined next June at about the time the adult sawflies begin to emerge, when the maximum effect of the treatments in controlling the overwintering larvae should become evident.

An intensive survey of the heavily infested sawfly territory, namely, Montana east of the Rocky Mountains, North Dakota, and a portion of northern South Dakota was started in September and will not be completed until early November. The purpose of this survey is to delimit the areas of severe threatening and non-economic infestation and to obtain an estimate of sawfly damage to the 1948 wheat crop. Ten well distributed wheat fields were visited in each county of the area surveyed and four representative samples of wheat stubble and fallen wheat heads were taken from each field. These samples were sent in to the field headquarters and some time will be required to examine them and analyze the data. When all the results of the survey are in a report will be prepared with a map showing the infestation in five different catagories -- trace, light, moderate, heavy, and severe. In general, wheat stem sawfly infestations were heavy and extensive in Montana and North Dakota again this year.

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Ralph D. Mercer - "Sawfly Situation"

Sawfly has not shown any great spread in Montana during the past year. Many growers are using Rescue wheat as a sawfly trap around the border of their fields. Considerable Rescue wheat was reported as sold to North Dakota growers in the winter of 1947-48.

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DINNER PROGRAM

The dinner program was held the evening of November 2, 1948. Dr. W. E. Sackston, Dominion Laboratory of Plant Pathology, University of Manitoba, Fort Garry was the speaker of the evening. He gave a very interesting discussion of the flax disease problems in Canada.

Dr. R. J. Haskell expressed the appreciation of the group to the Northwest Crop Improvement Association for the dinner and the work of their secretary in arranging for the Minneapolis Extension Conference.

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November 3, 1948.

INSECT CONTROL

Clinton Zinter - "Chemical Cricket Control Report".

"Infestations of the common field cricket have been serious enough this season to cause important crop damage; reports of losses vary from 1% to 50%. Cricket damage has been reported and observed almost the complete length of the Red River Valley -- from Wheaton, Minnesota to the Canadian border on both sides of the river. Infestations were spotted rather than uniform in the area. The primary crop damaged has been flax, and this damage has been more acute on fields surrounded by native pastures, legumes, wide roadsides and apparently summer fallow, and since flax is usually the last crop harvested, crickets from bordering harvested grain fields also move in.

"We tried various chemicals and means of application in an attempt to control the cricket in flax, using both air and ground equipment (weed sprayer) and applying Toxaphene (chlorinated camphene) liquid and dust, chlordan liquid, DDT wettable powder and emulsions and Parathion. All of these chemicals are poisons, and are regarded as toxic to livestock at the present time. Spraying and dusting of flax fields was done at Georgetown, Hillsboro, Hendrum, Portland and Cummings. Flax was sprayed standing and also in the windrow.

"An estimated 9000 acres of flax was treated in the Red River Valley this season. Most of this acreage was covered by airplanes using liquid sprays. Late season spraying with ground equipment has not appealed to farmers because of wheel damage, except of course in windrowed flax. The spraying of one or two swaths around a field and spraying strips in fields has been done, but results were not nearly as satisfactory as where the entire field was sprayed.

"Most farmers fail to notice cricket infestations until the damage has been done, as they are usually busy with harvesting and do not examine their fields. Also, the crickets go into the ground during the hot and windy portions of the day and are not readily noticeable at the time the farmer might check his field. In standing flax they feed primarily in the morning and evening.

"It seems to be the opinion of most farmers that crickets damage only windrowed flax and do so, principally, by cutting off heads. They will, however, do serious damage to standing green flax by eating into the bolls, but they are not as apt to cut off the bolls in standing flax as are grasshoppers.

"We got the best results with Chlordan and DDT in the control of crickets, but these results have been quite inconsistent. We obtained some good kills and some very poor, for no readily apparent reasons. It has been rather difficult to accurately judge cricket kills because of their habits. Crickets eat their own dead and also crawl into holes or cracks in the ground and are difficult to find. Toxaphene kills were generally poor and slow. Genithion S-15 (parathion) looked promising on the one small test conducted, but because of its reported high toxicity, it is rather difficult to work with.

"Our experience has been that both DDT and chlordan gave the best results when used as a contact spray, although both are stomach poisons and have a residual effect for from one to three weeks. It is difficult to get sufficient pressure and water to drive the chemicals through windrowed flax to the underside where most of the crickets are found and where they are feeding; therefore, results have not been as good on windrows. The chemicals can be obtained in dust form and some good kills have been reported using dust on windrows. It is easier to get the chemical in dust form in contact with the

Clinton Zinter - "Chemical Cricket Control Report" - continued

crickets under the windrows, but there are some disadvantages to using dust. Costs are increased, there is no residual effect in case of rain, and it is difficult to apply the dust evenly, especially from airplanes.

"Chlordan gave the fastest kills, with kills being nearly complete in 48 hours where good results were obtained. DDT didn't seem to take effect until the second or third day. Parathion showed definite effects in 24 hours.

"Chlordan was applied at the recommended rate of one pound per acre in five to ten gallons of water, at a cost of approximately $2.00 an acre for chemical used; DDT was applied at the rate of one to one and one-half pounds per acre at a cost of $1.50 to $2.00. The DDT was put on in from one to twenty gallons of water per acre, using a 50% wettable powder and a 25% emulsion. Toxaphene was applied at one and one-half pounds per acre in 5-10 gallons of water at a cost of about $1.50. Genithion S-15 put on at 1 pound per acre, costs approximately $1.25 for chemical. Chlordan, chlorinated camphene and DDT were put on at the rate of one and one-fourth gallons per acre of solution when applied by planes.

"If farmers in known heavily infested areas would spray the young crickets when they are still concentrated in hatching areas and easier to kill, and would spray as an organized community, it would certainly increase the control and cut spraying costs.

"In addition to the spraying done by this Department, several fields sprayed by commercial operators were checked and information and recommendations were obtained from the Entomology Department at North Dakota Agricultural College. It seems to us that both DDT and chlordan show enough effectiveness to warrant further use and observation. The present cost of these chemicals may limit their use in less prosperous years. Special studies are needed to find an efficient way of spraying windrowed flax, or possibly to develop a method of spraying it just before or as it is being windrowed. The majority of farmers are apt to wait until then to spray in the hope that the crop can be picked up in a few days and so escape injury. Rainy weather may upset these plans and insect damage will result."

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Claude Wakeland - "The Grasshopper Situation"

We know in a general way that there has been an increase in grasshopper populations in nearly all agricultural areas but cannot accurately evaluate the extent of increase or its importance until after the survey data are mapped in late November. Available data indicate that next year we might expect complete devastation of range and crop land in large areas in Montana if control is not undertaken systematically and in time and if the spring should be dry and early, favorable to the hatching and development of grasshoppers and unfavorable to the growth of range grasses. The infestation in western North Dakota appears to be somewhat up from last year and also in localized areas in South Dakota. The infestation in Minnesota, as you probably already know, is much more extensive than it was in the fall of 1947.

The grass hopper control problem was much greater in Wisconsin this year than in any other recent year. Survey data indicates it will be still greater in 1949, especially if there is a repetition of this year's drought in the central and northern parts of the state.

Iowa is expected to have a light to threatening infestation in the southern half of the state restricted mainly to legumes and to the margins of corn fields in individual localities.

Claude Wakeland - "The Grasshopper Situation" - continued

An indication of the way farmers are feeling about grasshopper damage is in the fact that during 1948 more bait was used than in any year since 1941. This is rather significant in view of the fact that it was the first year in which alternate insecticides were widely available and used. We do not yet have the figures on the number of acres which were treated with alternate insecticides but it is reasonable to conclude that more acres were treated for grasshopper control in 1948, including bait and sprays or dusts, than in any year since 1940, the last year of the general outbreak of Melanoplus mexicanus. It is significant also that even though a large amount of alternate insecticides was used the total bait estimate was exceeded and that the estimate was exceeded in nine of the ten states which conducted the greatest amount of control.

The most important thing in the present outbreak is the increase of the migratory species, Melanoplus mexicanus, which is evident throughout the western part of the Great Plains from Canada to Texas. This, as you will remember, is the species which was primarily concerned in the 1936-1940 outbreak.

As soon as maps and other data for the 1949 control year are available we shall be glad to place more complete information in your hands.

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"Treating alfalfa and sweet clover for insect control".

Iowa reported that the dusting of alfalfa had brought seed increases. Montana reported satisfactory results from the use of D.D.T. and Toxaphene. North Dakota reported satisfactory results. South Dakota reported an increase of seed had resulted at their stations but that farm field results from the use of chemicals had been variable. Minnesota reported variable results. The consensus of opinion seemed to be that there was a great deal to learn before successful results could be secured from dusting alfalfa with chemicals to control undesirable insects.

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W. E. Brentzel - "Results of Seed Treatment tests with Parson's Seed Saver, Panogen and Ceresan M".
Prepared by W. E. Brentzel and given by R. C. Rose.

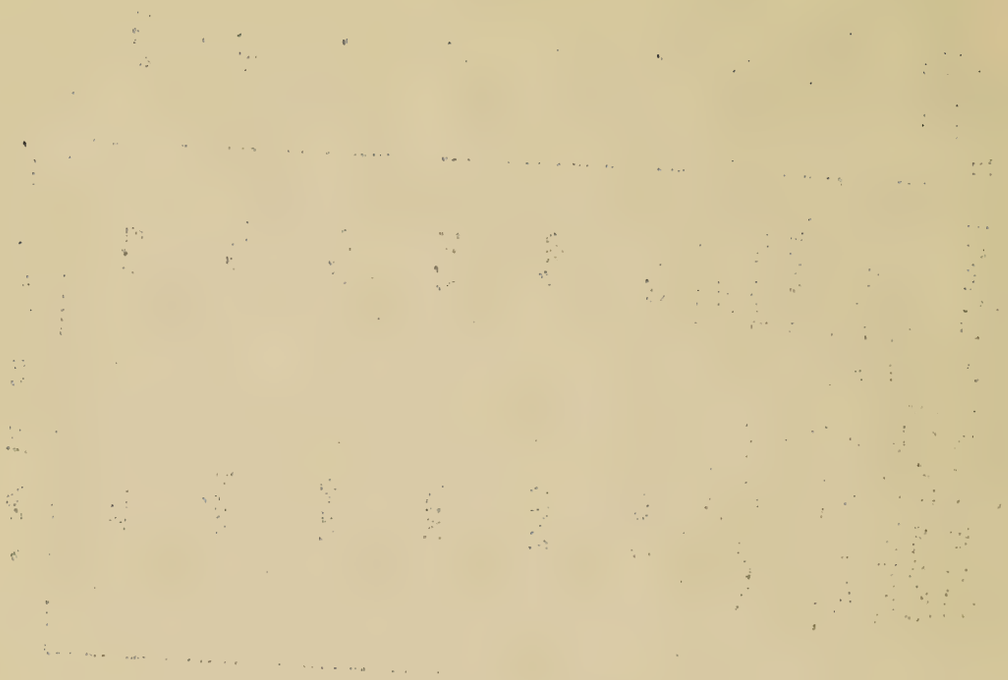
One lot of wheat seed and two lots of barley were treated and sown in separate plots. The data shows the effects on covered smut of wheat and barley. The value of the different treatments for control of covered smut I believe is shown with considerable significance. I am including the results from New Improved Ceresan, Ceresan M, Parsons SS dust and Panogen. In addition to these treatments I also included Dow's 9B, not that they are making any claims for this material as a treatments for cereal seeds, but because it is a rather strong disinfectant and has shown up well on certain other crops.

In the course of your work I am sure you have noticed the different degrees of smut which grain may carry. In selecting a sample of seed it is difficult to know just what sort of samples should be obtained for these tests. In the course of my work I have noticed that covered smut of barley is somewhat difficult to control with a dust treatment. Therefore, in the case of barley two lots of seed were selected: first, one carrying a medium amount of smut and one carrying a very heavy load. The sample of wheat which was chosen for the tests was very smutty. The seed was so smutty it appeared black from the smut spores.

Fargo, 1948.

Treatment	WHEAT - SEED TREATMENTS FOR COVERED SMUT (Table No. 1) VERY SMUTTY SEED - BLACK			BARLEY - SEED TREATMENTS FOR SMUT (Table No. 2) MEDIUM SMUTTY SEED (randomized Rod-rows)		(Table No. 3.) VERY SMUTTY SEED
	Total Number Heads	Percent Covered Smut	Yields (Grams)	Total Number Heads *	Percent Covered Smut	Percent Covered Smut
N. I. Ceresan 1/2 oz. per bu.	4932	1.15	2790	3740	0.29	0.2
Ceresan M 1/2 oz. per bu.	4863	0.78	2755	3374	0.59	24.3
Parsons SS 1 oz. per bu.	5076	10.52	2565	3428	3.41	10.9
Dow's 9B 3 oz. per bu.	4852	6.78	2770	3469	2.58	0.5
Panogen, slurry 1½ oz. per bu.	5079	0.17	3055	3536	0.00	20.1
Control, no treatment	5284	19.04	2470	3728	6.30	21.2

* Totals from 6 rod rows.



W. E. Brentzel - "Results of Seed Treatment tests with Parson's Seed Saver, Panogen and Ceresan M" - continued

In my work I have not been able to obtain perfect control of smut with New Improved Ceresan when very smutty seed is treated. The 1.15% smut obtained from seed treated with Ceresan (Table 1) is not unusual. In my judgement this is a fair control of smut, although it does appear rather high when you see the figure. If average smutty seed had been used I am quite sure that near perfect control would have been obtained by the use of Ceresan. In different tests Ceresan M showed up about the same as New Improved Ceresan. Panogen was very effective against covered smut of wheat, although the seed, as indicated, was very smutty. In Table 1, I would consider the results from New Improved Ceresan, from Ceresan M, and from Panogen as quite satisfactory. The results from the other treatments were not satisfactory, in so far as control of covered smut is concerned.

In Table 2 containing the results from treating medium smutty barley, the results obtained with New Improved Ceresan, Ceresan M and Panogen again seem satisfactory. The other treatments cannot be considered as very effective.

Table 3, showing the results obtained from treating very smutty barley. In this test New Improved Ceresan seemed to be quite effective and Dow's 9B also showed up quite well. I am not sure just why this treatment gave apparently good control and Ceresan M did not. I am considering the results from 9B as incomplete and because of this low figure of smut the test should be repeated before any importance is attached to the results. I am inclined to think that the results from Ceresan M and Panogen are more reliable. In other words, when very smutty barley is treated I would be inclined to recommend New Improved Ceresan, but as yet, I would not recommend Ceresan M nor Panogen. None of these results are to be considered as finial, but in the past we have often observed the lack of effectiveness of some of our better disinfectants when used on very smutty seed. I might say that in this connection the old formaldehyde treatment, when used as a wet treatment, was superior for smut control. Of course, we are not thinking at all of recommending formaldehyde for other very good reasons with which you are familiar.

In general, as the picture now appears to me, we shall be able, under average amounts of smut, to continue to recommend New Improved Ceresan, Ceresan M and perhaps Panogen when used as a slurry. Panogen carries considerable merits not only from the stand point of disease control, but also, as a material which may be easily applied.

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SOIL CONSERVATION

Leonard L. Ladd - South Dakota
(report attached)

Summary of Soil Conservation Discussion.
Leonard Ladd, Matt Thorfinnson and Irvine T. Dietrich.

The two phases of soil conservation receiving the most attention in this discussion were protection of summer fallow and maintenance of a satisfactory level of organic matter.

1. Vegetative cover for protecting summer fallowed land. Black land carries a higher temperature in summer in the surface soil (top 4 to 8 inches) than does soil covered with vegetation. This difference in temperature has its effect on biologic activity. Experiments in North Dakota indicate crops planted on stubble mulched land may suffer from a shortage of nitrogen, especially during the early part of the growing season. Will the application of a small amount of (nitrate) nitrogen remedy this condition?

The methods and machines for doing stubble mulch tillage are pretty well known. The main problems are developing a system for the various types of soil: a system that will control weeds, protect the soil from erosion, operation at low cost and a yield comparative to that obtained by the more common tillage methods.

Experiment station tests indicate sub-surface or stubble mulch systems have possibilities from a yield and cost viewpoint. Farmers are demonstrating that systems of farming which maintain a vegetative cover on the soil is possible and that such systems are financially sound.

2. It was generally agreed that maintenance of a satisfactory organic matter level in the soil is the most important soil conservation consideration.

Grass-legume mixtures in rotation with crops likely has the best chance of success in this direction.

Contour farming, terracing, stubble mulch tillage, drainage systems, tree belts, sound pasture management and water developments are all necessary in attaining soil conservation. However, to be successful, they will have to be buttressed by a sound crop rotation which includes a grass-legume mixture. Other practices that may help maintain a satisfactory level of organic matter in the soil are:

Return all crop residue to the soil.

Sweet clover green manure.

Manure.

Commercial fertilizer.

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GRAIN VARIETY DISCUSSION

Barley varieties were discussed. The only new malting variety is "Moore" from Wisconsin. This variety shows promise in areas where Wisconsin 38 proved satisfactory. It matures about the same time as Wisconsin 38 but is more resistant to root rots. Montcalm was reported to be grown on a considerable acreage. The group is waiting for the report from the Midwest Barley Improvement Association before any Montcalm recommendations can be made. Iowa reported that the application of phosphate increased their barley yields.

Grain Variety Discussion - continued

Mr. E. J. Mitchell reported that Dakota flax was lower in oil content than other approved varieties. He further stated that the 1948 crop of flax from Montana and North Dakota contained a higher oil content than flax from other localities that year.

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SOILS AND FERTILIZERS

Mr. Paul Burson refers us to Extension Bulletin 254, "Soil Fertility and Conservation" published in March 1947.

Mr. Burson reported that 600 demonstrations for the use of fertilizers had been held during the past three years.

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PASTURE PROGRAM

Wisconsin reports that they are promoting forage crops rather than just a pasture program. Their state land classification is as follows: 15 million acres of timber and recreation area; 5 million acres wooded pasture; 3 million acres tame pasture (blue grass); 2 million acres tame pasture and plowable land. They have about 4 million acres of hay, chiefly clovers; 1 million alfalfa; 3 million small grains, and 3 million corn. More than one-half of the corn is used for silage. 90% of the Wisconsin farm income is received from livestock and livestock products. Pasture renovation has been promoted with the use of better pasture mixtures and the use of grass silage because too many alfalfa leaves are lost in the production of alfalfa hay. Grassland Field Days were held with follow-up meetings after the Field Days.

Minnesota has an over-all pasture Committee and local pasture Committees in counties where work is being done. Farmers were recognized who followed a good pasture program. This recognition was sponsored by Minnesota seedsmen, fertilizer companies and the State Dairy Association. Seven hay and pasture meetings were held through the cooperation with the machine companies. A total attendance of 32,000 was reported. A three-reel film was made and follow-up meetings held. Attempts have been made to cut the cost of hay making and interest people in the necessity of more Hay. Field Days and Machinery demonstrations were held at which mowers, side-delivery rakes, hay choppers, hay loaders, bailers, buckrakes and stackers were demonstrated. Sixty to seventy pieces of equipment were displayed and demonstrated at these meetings. Some hay was cut prior to the meeting so that it would be dry and ready for use with hay making machinery. A discussion of hay making, hay silage and the use of the various equipment was held at each meeting.

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1949 MEETING

At the close of the Conference a motion was made by Ralph D. Mercer and seconded by E. S. Dyas that a two-day Extension Conference be held annually in the fall, and if possible, in cooperation with the Flax Institute. Dr. R. J. Haskell commented that these were excellent get-togethers and it affords a fine opportunity to review the results of the past season's work, also that the Conference would help in planning the next year's program.

The group further suggested that next fall, one-half day be spent on pasture improvement discussion, also that more time be given to insect and disease problems.